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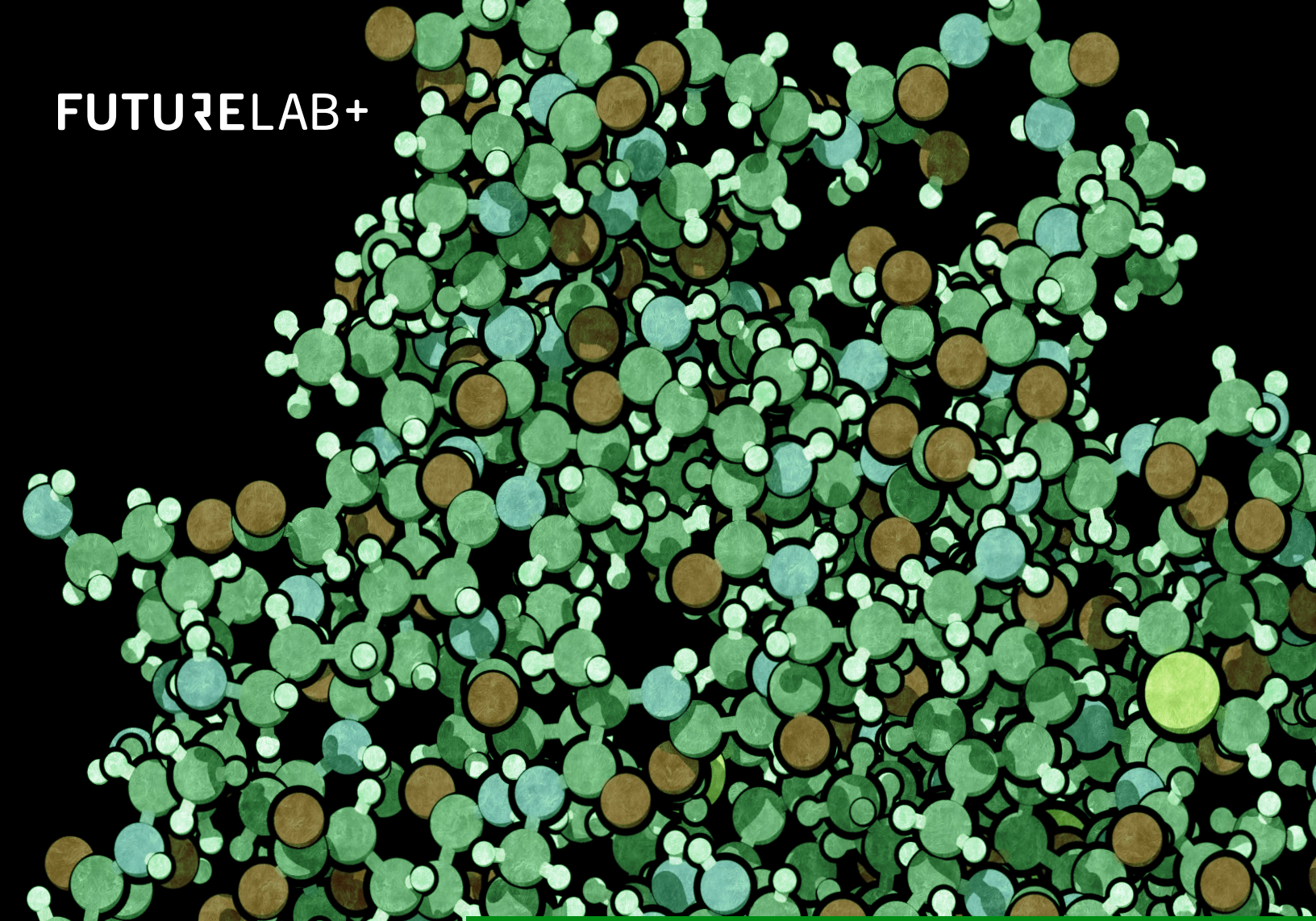

AG/ENVIRONMENTAL

Alternative Proteins

Bioethics Debate

Developed in partnership with:

Discovery Education and Ignited

In this Lesson Plan:

Print the **Teacher Section** →

Print the **Student Section** →

This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

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Cover Image
This model of a protein in cow's milk is a common allergen. Could a genetically engineered modification help?

AG/ENVIRONMENTAL / ALTERNATIVE PROTEINS

Bioethics Debate

DRIVING QUESTION

Is Golden Rice the best solution for the community challenge of Vitamin A deficiency (VAD)?

ACTIVITY DURATION

Four class sessions
(45–50 minutes each)

ESSENTIAL QUESTIONS

Who supports the production and commercialization of Golden Rice in the Philippines?

What arguments support or refute Golden Rice as a solution to Vitamin A deficiency (VAD)?

How can a group of stakeholders communicate to draw conclusions?

OVERVIEW

Now that students have an understanding of Golden Rice and its impact on the Philippines, they will aim to establish a position on whether Golden Rice is the best solution for malnutrition in this community. Solutions for community challenges can take many forms, such as increased education or improving social programs, and genetic engineering is one approach among many. With this in mind, a major question remains: Is this GE technology solution the best solution for combating Vitamin A deficiency?

In this lesson, students will be debating this question from multiple perspectives, including stakeholder with a vested interest in the production of Golden Rice and a stakeholder from the Philippines who opposes this GE product. Students will take a deep dive into the concerns and hopes of different stakeholders from the Philippines. The class will then engage in a Socratic Seminar with each student group representing the opinions of their stakeholder with a conscious effort to practice equity, empathy, and respect as group conclusions are made.

OBJECTIVES

Students will be able to:

Identify the stakeholders and their position on the impact of Golden Rice in the Philippines.

Describe the pros and cons of bringing Golden Rice into the Philippines using sources from their research.

Debate Golden Rice from the perspective of the assigned stakeholder.

Compare Golden Rice in the Philippines to Golden Rice in their community.

Materials

- **Stakeholder Information Sheets**
- **Stakeholder Interviews**
- **How to Identify a Good Source**
- **Position Statement Capture Sheet**
- **Counterclaim Capture Sheet**
- **Individual Reflection Capture Sheet**
- **Project Notebook**
- **Computer and Internet Access**

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

Social-awareness is a prominent focus of this lesson as students aim to practice empathy and understanding of people from a community other than their own. Responsible decision-making is central to this lesson during the debate portion. Students will practice open-mindedness and recognize strengths in other positions. Communication and relationship skill development serve as an asset in this unit in which students engage in sharing their stakeholder viewpoint to the large class community.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Students are finding where they have connections and building empathy with Filipino culture and representative stakeholders. Students will be integrating Filipino culture into position statements for stakeholders and structuring debate arguments in a way that is culturally relevant and responsive to the larger conversation.

ADVANCING INCLUSIVE RESEARCH

Students will consider the opinions of a diverse set of stakeholders around the use of Golden Rice in the Philippines, and will participate in a discussion from the viewpoint of these diverse perspectives. They will reflect on the idea that engaging diverse populations in research is not always a straightforward decision, but has nuances that need to be carefully considered.

COMPUTATIONAL THINKING PRACTICES

During this lesson, students will learn and teachers will model how to formulate computational solutions to the problem of VAD through communal discussion, including opportunities to give and receive actionable feedback around a position. Students will also establish a learning environment that values and encourages varied viewpoints, student agency, creativity, and engagement through a student-led discussion.

CONNECTION TO THE PRODUCT LIFE CYCLE

In this lesson, students take on the role of multiple stakeholders to debate the case study of Golden Rice. This approach both spotlights current GE technology and builds students' connections to multiple stakeholders as part of both the **discover** and **develop** phases of the product life cycle.

Have you ever wondered…

Who is impacted by GE technologies?

Everyone in the Philippines, from the local farmers to children directly impacted by malnutrition, has the potential to be impacted by the development of genetically modified Golden Rice. The impact of GE technology on Filipino communities can be applied at a global scale with a focus on humanitarian and public health efforts.

Who should be considered when considering a new GE technology production?

Many groups have interests in new GE technology developments. Groups that need to be considered during the development phase are the approval boards, governing bodies (such as the Food and Drug Administration or United States Department of Agriculture), funders, and sustainability groups need to be considered. During the implementation phase, community members need to be considered, including farmers, store owners, healthcare providers, and consumers.

A laboratory scientist looks into a microscope.

How are GE technology decisions made?

Many GE products are designed in the lab by scientists to solve a problem. That problem might be identified by the scientists or by other interested parties, such as the funders of the research, a university, an organization, or the government. Prior to implementation, most interested parties will involve stakeholders in the final decision making for how, when, and if the GE technology will be implemented.

MAKE CONNECTIONS!

Close up of rice seeds ready for harvesting.

How does this connect to the larger unit storyline?

This lesson will allow students to increase empathy for different stakeholders as well as gain an understanding of all the stakeholders involved in bringing a new GE technology to market. They will need to identify stakeholders in their local community to interview or survey about their novel GE product later in the unit.

A Filipino rice farmer.

How does this connect to careers?

This lesson is designed around multiple stakeholders that are career-aligned. Three examples with which students may be less familiar are:

Local (rice) farmers are in charge of food production, often from seed to harvest to distribution. They make decisions about the crops to plant, when to plant them, and how to maintain their land throughout.

Foreign service workers are involved with the economic and trade policies surrounding the distribution of food, including imports and exports. They might be involved with monitoring safety, determining acceptable practices, and negotiating food trading plans with other countries.

Nutritionists advise people on what to eat in order to lead a healthy lifestyle or a specific health-related goal. They need skills of listening, data interpretation, and patient awareness to be effective in changing people's habits.

How does this connect to our world?

This is a real-world example of a novel GE introduced in a different country to help solve a community challenge in that country.

Day 1

Procedure

LEARNING OUTCOMES

Students will be able to:

Identify stakeholders that are impacted by Golden Rice in the Philippines.

Small Group (45–50 minutes)	
1	Prior to class starting, post *Stakeholder Information Sheets* on the wall around the classroom. Spread out the capture sheets so that groups can easily move among the stakeholders to learn about them.
2	Place students in groups of three, and assign them to their first stakeholder.

Teacher Note > *Students will be participating in a Triad Socratic Seminar on Day 4. One group member will be the pilot (speaking) group member and the other two will be copilots (research and source support for the pilot) during the Socratic Seminar. This may need to be considered when grouping students. These groups of three will do all the activities together throughout this lesson to prepare for the seminar.*

3	Have students read the first stakeholder sheet. In their group, they should discuss the following questions (also display these questions at the front of the class for easy reference):
	a. What do you relate to about this stakeholder?
	b. What questions do you still have about this stakeholder?
	c. Do you agree with his or her ideas so far?
	d. Would you want to represent this stakeholder in the debate?
4	After three minutes, have students rotate to the next stakeholder.
5	Continue student rotation every three minutes until they have read all the *Stakeholder Information Sheets*.
6	Prior to leaving, have each group write down their top three choices (in order of preference) of stakeholders they want to represent in the debate at the end of the lesson.
7	After class, assign the roles to each group, making sure that each group gets a different stakeholder. For smaller classes, the plant geneticist, biomanufacturing technician, and bioethicist can be omitted. For larger classes, there can be multiple local farmers, nutritionists, and sustainability managers in the debate.

Day 2

LEARNING OUTCOMES

Students will be able to:

Identify a stakeholder's position about Golden Rice being brought to the Philippines and relate to the stakeholder's personal experiences.

Describe the pros and cons of bringing Golden Rice into the Philippines using sources from their research.

Procedure

Small Group (10–15 minutes)

1. Give each group the *Stakeholder Information Sheet* for their assigned stakeholder. Give each group member the *Stakeholder Interview* associated with their assigned stakeholder. These interviews use "GMO" as it is the recognizable term.

2. Have groups read the interview together. Each student should annotate their interview. Details they should look for and highlight include:
   - **a.** Who the person is.
   - **b.** The person's position on Golden Rice, including the reasoning behind that position.
   - **c.** Information that might be helpful to counter other group's claims.

Whole Group (5 minutes)

1. Hand out the *How to Identify a Good Source Capture Sheet* to each student.

2. Review the capture sheet with the class.

Small Group (25–35 minutes)

Allow students to research additional sources that support their stakeholder's position on GE products and Golden Rice. For example, *Genetically Modified Foods and Social Concerns* might be a good place to start.

Teacher Note > *The stakeholder interviews should serve as a starting point for forming the perspectives of the stakeholders in the debate. Guide students in forming research-based statements these stakeholders could use in their debate rather than relying solely on the interview statements and anecdotal evidence. Share that the formation of perspectives on this topic is complicated and varies widely, so attempting to form a perspective that includes many perspectives of your stakeholder will benefit the discussion as a whole.*

Day 3

Procedure

LEARNING OUTCOMES

Students will be able to:

Describe the pros and cons of bringing Golden Rice into the Philippines using sources from their research.

Make a claim on the introduction of Golden Rice and defend their stance using evidence.

Whole Group (10 minutes)	
1	Introduce the Socratic Seminar format. Each group will have a pilot (the person in the Socratic seminar circle participating in the debate) and two co-pilots (sitting behind the pilot and feeding the pilot sources, information, and counterpoints during the Socratic Seminar).
2	Have groups decide which group member will take on which role.

Small Group (40 minutes)	
1	The pilot should work on the *Position Statement Capture Sheet*. Pilots will want to include as many summary statements as possible to support their original claim about Golden Rice.
2	The co-pilots should work on the *Counterclaim Capture Sheet*. Some stakeholders will not be listed as they should be the group's stakeholder's allies in the debate. Stakeholders that are used might be used more than once as they have multiple claims that need to be refuted.
3	Students might need to research further to find more sources to support their claim or counterclaim, or to identify what claims other groups might try to make.

Day 4

LEARNING OUTCOMES

Students will be able to:

Engage in a debate about Golden Rice from the perspective of the assigned stakeholder.

Apply their knowledge of Golden Rice in the Philippines to Golden Rice in their community.

Procedure

Whole Group (30–40 minutes)

1. Start *Socratic Seminar: Triad Formation* by having each pilot state a position statement. Remind co-pilots that they should be taking notes on other groups statements to help the pilot counter their claims.

2. Questions to get the Socratic Seminar started or rebooted:

   a. What is the best continuing solution for the nutrition problem in the Philippines?

   b. Which voices in the room should be elevated the most in this decision?

   c. How can Golden Rice be used in the United States to solve a problem?

3. Challenge questions in the debate can focus on positions that may counter the main topic. Engage students by proposing the following prompt:

   Some community members are at this Socratic Seminar to express concern about GMOs. They believe these products are dangerous and that other solutions such as education should be the focus for solving Vitamin A deficiency instead of Golden Rice.

   How do you respond to this?

Individual Work (10 minutes)

1. Have each student fill out the *Individual Reflection Capture Sheet* as homework or prior to leaving class.

2. Each student should complete the Develop – Safety section of their Project Phase Chart Capture Sheet from the **Project Notebook**.

National Standards

Next Generation Science Standards

ETS1-1
Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

ETS1-4
Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Science and Engineering Practices
Engaging in Argument from Evidence
Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

Career and Technical Education (CTE)

A1.4
Research and identify public misunderstandings related to biotechnology and discern the source of these misunderstandings.

A2.1
Know the relationship between morality and ethics in the development of biotechnology health care products.

A2.4
Understand the critical need for ethical policies and procedures for institutions engaged in biotechnology research and product development.

7.8
Explore issues of global significance and document the impact on the Health Science and Medical Technology sector.

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National Standards

CTE *Continued*	**9.5** Understand that the modern world is an international community and requires an expanded global view.
	9.6 Respect individual and cultural differences and recognize the importance of diversity in the workplace.
	9.7 Participate in interactive teamwork to solve real Health Science and Medical Technology sector issues and problems.

Position Statement Capture Sheet

ANSWER KEY **Do not share with students**

Directions
To prepare to participate as a pilot in the Socratic Seminar, describe your stakeholder's position on Golden Rice. Identify statements to support this position.

Answers will vary with the Stakeholder chosen.
Below is an example.

Stakeholder

Nutritionist

Position statement

I am a nutritionist and

I believe that Golden Rice is a *good / bad (circle one)*

idea for this community because…

list up to three main points to support your position.

Vitamin A deficiency is a public health crisis that needs to be addressed, especially in underdeveloped countries.

Statements
Support your position with as many claims as possible.

- Malnutrition and the development of Golden Rice has the potential to impact everyone in the Philippines, whether directly or indirectly.
- Vitamin A deficiency can cause blindness and weaken the immune system for vulnerable children, leading to death. Thus combating the deficiency is significant and necessary.
- Nutrition is vital to leading a healthy lifestyle or achieving a health-related goal, and with a lack of Vitamin A in a diet, one's nutrition is lacking.

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Position Statement Capture Sheet

ANSWER KEY **Do not share with students**

Continued

Source *Note each source of the summaries cited during the debate.*	Prediction *List all the stakeholders you expect to be on your side during the debate.*
Answers will vary.	Local farmer Lobbyist Local parent Nutritionist

Counterclaim Capture Sheet

ANSWER KEY **Do not share with students**

Directions
To prepare to participate as a copilot in the Socratic Seminar, describe the position of your pilot's stakeholder on Golden Rice. Identify statements to support this position.

Answers will vary with the Stakeholder chosen.
Below is an example.

Stakeholder

Local Rice Farmer

Position statement

I am a local rice farmer and

I believe that Golden Rice is a *good / (bad) (circle one)*

idea for this community because…

list up to three main points to support your position.

- There may be no demand for this new type of rice.
- If I plant GMO seeds, they may mix with the natural rice that grows in the area.
- I may be caught into continually paying for more GMO seeds to plant every year.

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Counterclaim Capture Sheet

ANSWER KEY **Do not share with students**

Continued

Stakeholder *Which stakeholders might be against your position in the debate?*	**Potential claim** *What points might they make during the debate to make your position weaker?*	**Counterclaim** *What can you say to refute or prove their claim wrong?*	**Source for counterclaim**
Plant Breeder	GE seeds are quite common in my line of work, which communicates that they do have a market.	However, there are so many types of rice and other GE crops that Golden Rice may be lost in the noise of other products.	Answers will vary.
Plant Geneticist	Agriculture today is dependent on GE tech and it is feeding the world through healthier, more productive crops for which there will always be a market.	Trends can change and people's attitudes towards GE can cause a negative shift for the market of Golden Rice.	Answers will vary.
USDA Foreign Service Worker	Golden Rice may have its ups and downs in the market. With more demand in impoverished countries, there can also be potential markets in both Asia and the United States.	The United States and other developed countries are not affected by VAD and thus do not have a market for Golden Rice, making profit a greater variable.	Answers will vary.
Nutritionist	Eating healthy and maintaining a good lifestyle and goals should be prioritized rather than more personal profit.	If people don't buy Golden Rice my health and daily living are impacted if I start producing it without any demand.	Answers will vary.
Local Parent	We need to take care of our children and if Golden Rice provides Vitamin A we should think less about profit and the potential good it can produce.	Golden Rice is more expensive than traditional rice and your child can stay healthy in other ways.	Answers will vary.

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Stakeholder Information Sheets

Directions
Your group will rotate to read all stakeholder sheets. You should spend about three minutes on each stakeholder. As you rotate through, keep in mind the stakeholders you might want to represent in the debate at the end of this lesson.

Plant Breeder

Job Description	Plant breeders research seed characteristics and aim to improve those characteristics that are most desirable, such as yield, size, quality, maturity, and resistance to frost, drought, disease, and insect pests.
Average Salary	$60,000–110,000 per year
Quote from individual	I use GE seeds all the time in my line of work. There are many advances in growing abilities of the seeds that make it easier for seeds to produce more hearty crops. It is a challenge to keep the seeds of non-GMOs separate from the seeds that have GE technologies used on them, especially when shipping in the international market. GE soybeans have been found in shipments of non-GE soybeans, for example.
Sources	*Plant Breeder*, *Plant Breeder Salary in California*, *Plant Breeder | Career Profile*

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Stakeholder Information Sheets

Continued

Plant Geneticists

Job Description	Plant geneticists conduct research to understand, improve, or create new varieties of plants or crops. Looking at a plant's DNA, they can examine ways to isolate and then develop certain plant traits, such as shape, size, production level, pesticide, and disease tolerance.
Average Salary	$56,000–120,000 per year
Quote from individual	GE plants are my bread and butter. The amount of agriculture that is based on GE technologies would surprise the average consumer. From drought resistance to insect resistance, GE technologies can do it all! I am really helping feed the world through healthier, more productive crops. I am really excited by the new advances in increased nutrition from GE technologies.
Sources	*Plant Geneticist*, *Salary: Plant Geneticist*, *Plant Geneticist | Career Profile*

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Stakeholder Information Sheets

Continued

Biomanufacturing Technician

Job Description	Biomanufacturing technicians can work in the upstream (material creation, growing under controlled conditions, and manufacturing of seed products) or downstream (harvesting, testing, purifying, and packaging the product) operations. They are responsible for the daily work of the lab or production line.
Average Salary	$27 per hour or about $55,000 per year
Quote from individual	If the production facility has both GE crops and non-GE crops coming through, it gets really hard to keep them apart. We do our best to keep them separate. But if there's not enough Golden Rice to fill a facility, I worry that it will get mixed with the non-Golden Rice. Keeping them separate is part of my job. It seems like a headache to me.
Sources	*Biomanufacturing TechnicianDownstream*, *How to Become An Upstream Biomanufacturing Technician: Step by Step Guide And Career Paths*

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Stakeholder Information Sheets

Continued

Local Rice Farmer

Job Description	A farmer's tasks vary according to the type of operation. A farmer who raises crops will be responsible for preparing land for planting, caring for the crops, and harvesting. Some farmers sell their own crops at market, while others have contracts with processing companies or other organizations.
Average Salary	50,000-60,000 Philippine pesos (approximately $1,000–1,200) per year
Quote from individual	Keeping this organic is my preferred method of farming. You know what you are getting with the seeds. You know how to grow them. You know the product will sell at the market. And you know you are helping to feed your community good healthy nutrition.
Sources	*Duties & Responsibilities of Farmers*, *Gov't urged to take into account incomes of farmers, fishers*

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Stakeholder Information Sheets

Continued

Corporate Farm Manager

Job Description	A farm manager's responsibilities include monitoring staff, crops, and livestock; purchasing supplies; preparing budgets and reports; and ensuring maximum profit. Farm managers maintain professional networks and keep abreast of developments in agricultural science.
Average Salary	$40,000–50,000 per year
Quote from individual	We use many GE crops in my industry. They have a great advantage for increasing production, such as stopping crop-killing insects. They are really great in making my job easier. When it comes to Golden Rice, I do not know how it could benefit me from a production standpoint. If it grows and produces at the quantity of my normal rice, then it doesn't matter either way. I just can't fall below my output margins and what I am doing now is working for me.
Sources	*Farm Manager Job Description*, *Adjust Farm Manager Salary*

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Stakeholder Information Sheets

Continued

National Sustainable Agriculture Coalition Lobbyist

Job Description	Coalition Lobbyists work to represent a group of people to legislators. To do so, they need to understand the needs of the people they are representing, as well as the political forces and opportunities. They advocate on behalf of their members' interests. Coalition lobbyists can influence and inform conversations happening in political committees, including bills proposed and drafted, and funding at the federal level. They need to quickly organize their members' opinions into concise and poignant arguments. They need to read between the lines and take advantage of opportunities that arise.
Average Salary	$60,000–100,000 per year
Quote from individual	While GMOs are not necessarily bad for human health, there are concerns about their larger impact. What impact will they have on communities? What jobs or other products will they replace? How will farmers be impacted? These questions are not always taken into account when designing and marketing the GMOs.
Sources	*What Is a Lobbyist? (And How To Become One)*

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Stakeholder Information Sheets

Continued

Sustainable Agriculture Program Manager

Job Description	Sustainable agriculture program managers are responsible for providing scientific data analysis and sustainable agriculture research support for farming operations. They summarize resource use on the farm and make sure that all environmental regulations are being followed. They also help implement sustainable farming practices to increase the production of the farm.
Average Salary	$77,000 per year
Quote from individual	GE technology in agriculture is a challenging topic. There are some really great things about GE crops, such as being drought-resistant and therefore having a lower impact on the environment while still feeding people. But there are also some really unknown consequences. If we make a crop that a certain insect will not eat, the population of that insect may decrease. There will be fewer insects of that type for other animals to eat and it can alter the entire food web of the area. We need to be very careful about what type of GE crop we are planting and what unintended consequences it might have.
Sources	*Sustainable Agriculture Program Coordinator*, *Average Environmental Program Manager Salary 2021: Hourly and Annual Salaries*

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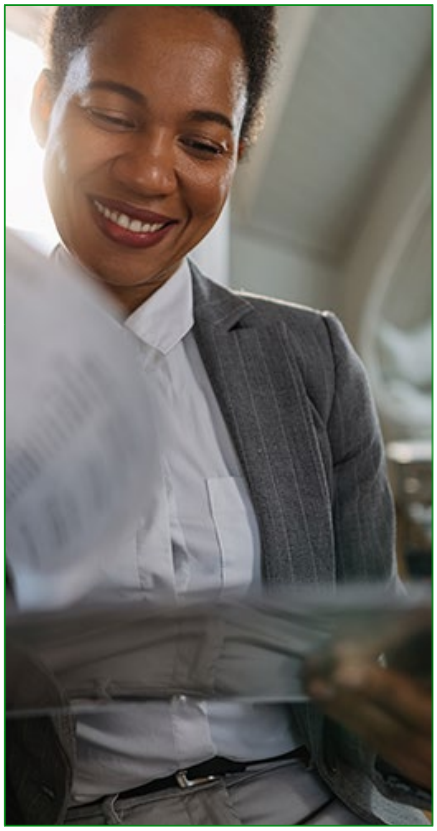
Stakeholder Information Sheets

Continued

Economist



Job Description	Economists collect and analyze data, research trends, and evaluate economic issues for resources, goods, and services.
Average Salary	$105,020 per year
Quote from individual	The success of Golden Rice could open a new market that has the potential to deliver high returns. If it is successful, there could be a drastic increase in the production of other genetically modified crops, which could lead to the development of new GMO companies. In turn, thousands of new jobs will need to be filled. There would then be a decrease in the unemployment rate, which is a sure sign of a strong and growing economy.
Sources	*Economists: Occupational Outlook Handbook,* *The Economic Impact of Golden Rice*

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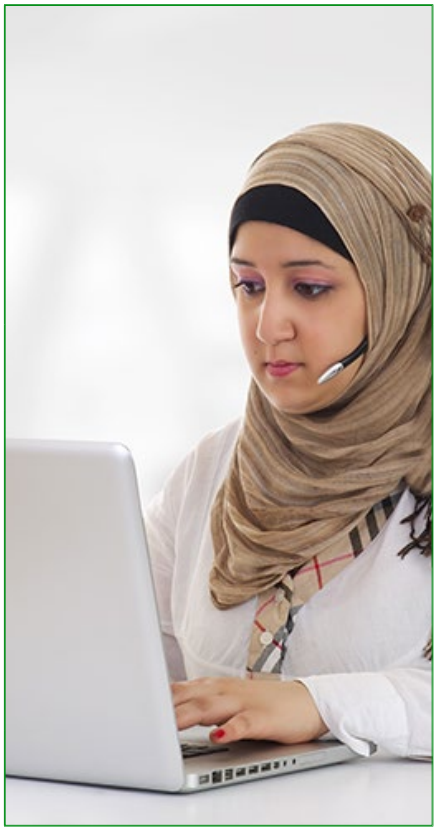
Stakeholder Information Sheets

Continued

Non-Governmental Organization (NGO) Employee



Job Description	An employee at an NGO focused on hunger will prepare and lead nutrition education programs for local families or educators, prepare reports of monthly impact, evaluate food programs, and interface with local governments as well as prominent community members to enhance education impact.
Average Salary	$40,000 per year
Quote from individual	Golden Rice is very needed in the Philippines. The amount of malnutrition in the children here is high. Culturally, rice is so important for all to eat, including children. It connects the family unit. We need to find more ways to make rice have higher nutrition to avoid malnutrition and all the horrible health consequences that go along with it.
Sources	*Action Against Hunger—Current Openings*

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Stakeholder Information Sheets

Continued

Bioethicist

Job Description	Bioethicists analyze parts of real or potential health care actions and provide ethical justification for the decisions made. They act as educators, advisors, and liaisons for healthcare providers, families, and patients.
Average Salary	$88,000–208,000 per year
Quote from individual	Ethically speaking, if there are no health consequences and only health benefits, Golden Rice should be used to fix the malnutrition problem in the Philippines. Saving a person's life and greatly enhancing the quality of that life should be the goal of all scientific advances. Golden Rice does both of these things.
Sources	*Bioethicist—Care and Psychosocial Support Coordinators—Health Care Team—ECHO Resource*, *What Does a Bioethicist Do?—Salary, Job Description & Required Education*

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Stakeholder Information Sheets

Continued

Nutritionist

Job Description	Nutritionists advise people on what to eat in order to lead a healthy lifestyle or achieve a specific health-related goal. They also develop programs and counsel the public on topics related to food, health, and nutrition. They often work with specific groups of people, such as adolescents or the elderly. They work in public health clinics, government and nonprofit agencies, health maintenance organizations (HMOs), and other settings.
Average Salary	$61,000 per year
Quote from individual	Nutritious food is extremely important for human health. Vitamin A is found in food products such as carrots, leafy greens, and eggs, and is essential for developing eyesight and a healthy immune system. Not all families have access to these foods. Genetic engineering technology has the potential to address nutritional deficits, such as Vitamin A deficiency.
Sources	*Dietitians and Nutritionists: Occupational Outlook Handbook*, *Biofortified crops for tackling micronutrient deficiencies—what impact are these having in developing countries and could they be of relevance within Europe?*

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Stakeholder Information Sheets

Continued

Local Parent

Job Description	Families residing in Filipino villages and cities
Average Salary	267,000 Philippine pesos (approximately $5,400) per year
Quote from individual	Part of my job as a mother is to provide for my children. Food needs to be affordable and safe. We have a healthcare system to help with diseases. We need our food to be nutritious and healthy. The best way to do this is to leave it the way God intended it to be.
Sources	*Income and Expenditure*

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Stakeholder Interviews

Plant Breeder

Peter Waweru
Agronomist at Apollo Agriculture , a technology company based in Nairobi, Kenya that helps small-scale farmers maximize their profits

What do you think about GMOs?

I think GMO crops are a necessary part of the solution to food shortage problems in Kenya. They will not completely solve malnutrition and starvation, but it would help. We also need to address this problem with fertilizers and herbicides, by helping farmers learn improved farming techniques, and providing reliable access to water and financing for equipment.

How do GMOs play into your daily life or work?

GMO seeds offer drought tolerance and improved nutrition. We help farmers maximize their profits, making their farms sustainable. Genetically modified seeds and soil can enhance the yield of crops in water scarcity. We use information from their farms to understand crop production improvements.

What are your thoughts about Golden Rice?

We are more focused on corn than rice.

What was your favorite subject in high school, and why did you love it?

Math. It just made sense. And then I realized that economics was the application of math, so I studied agricultural economics.

If you could give a piece of advice to your younger self, what would it be?

Study computers.

What's a social cause you care about?

Helping small and medium-sized farmers increase their production and business capacities.

What's your favorite way to spend a day off?

I enjoy traveling.

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Stakeholder Interviews

Continued

Plant Geneticist

Angela Anandappa, PhD
Executive Director at Alliance for Advanced Sanitation, a non-profit organization based in Chicago, Illinois that is dedicated to a future with safer food, safer water and a healthy planet

What do you think about GMOs?

GMOs have been created using technology that makes very small modifications in the genome of a species. We currently have 9 GMO crops that can be grown safely and in ample quantities without causing harm to humans or to the ecosystem. Having these crops available to us helps feed many more people with nutritious food in ample quantities.

How do GMOs play into your daily life or work?

I purchase foods made from GMO crops of all kinds to feed my family and clothing made from GMO cotton.

What are your thoughts about Golden Rice?

Vitamin deficiencies can cause serious health conditions, including immune issues and even blindness. Golden Rice is one way we can improve nutrition in communities.

What was your favorite subject in high school, and why did you love it?

Physics. I loved physics probably because it allowed me to think about how the world works and what can happen when something is changed.

If you could give a piece of advice to your younger self, what would it be?

Get out and explore nature!

What's a social cause you care about?

Income inequality and climate change are two major issues I care greatly about, and much of my work is directly or indirectly linked to both.

What's your favorite way to spend a day off?

I love spending time with my family, exploring new places or new dining experiences and traveling.

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Stakeholder Interviews

Continued

Biomanufacturing Technician

Nyla Haddock
Production Associate at Ossium Health,
a biotechnology company in San Francisco, California

What do you think about GMOs?

I think crops can be genetically modified to grow faster while being resistant to pests, diseases, and other environmental factors that could affect the crops. On the other hand, I am unsure how GMO products can affect people in the long term, such as by causing unknown allergies.

How do GMOs play into your daily life or work?

With food evolution, GMOs are a constant factor in my daily life. A lot of what I eat is evidently genetically modified products like corn and cereal. Since moving to Indiana, this question also makes me wonder if any of the crops I pass in the local farms are genetically modified and if so what has been modified?

What are your thoughts about Golden Rice?

I assume Golden Rice started the trend of genetically modified foods. I think GMO products have impacted communities and regions that lack nutritional value that are essential for their immune system, development, and longevity.

What was your favorite subject in high school, and why did you love it?

Chemistry. I think I enjoyed this subject because our teacher would use real-life examples and create a lot of experiments for us to apply the topics we were learning about.

If you could give a piece of advice to your younger self, what would it be?

Humility and respect go a long way.

What is your most used phone app?

Instagram. Outside of work, I have a passion for cooking and baking so most of my time on Instagram is spent watching cooking/baking videos and reels. I love that people can share part of their culture and their recipes for others to try.

What's your favorite way to spend a day off?

I somehow love to mow so my day off is usually spent mowing the yard or if not, I love spending my day off hanging out with my two dogs.

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Stakeholder Interviews

Continued

Local Farmer

Jose Arellano
Family Farm Manager based near Sacramento, California

What do you think about GMOs?

Honestly, from what I know, GMOs are really not that good. Because they are genetically modified—it says it in the name. And anything that comes from a lab isn't really that good. Gotta keep it natural, keep it organic. Because everything is better as it is, natural.

How do GMOs play into your daily life or work?

Growing up on a farm I heard a lot about GMOs but then you don't really get to experience making the decisions about them until you are older and managing the farm. And my family has decided we want to just stay away from all those GMOs, we only buy organic seeds.

What are your thoughts about Golden Rice?

Well, I'm still not sure. Honestly, eyesight is really important—I think it's key to keep your eyesight. If you don't have your eyesight you can't do a lot of stuff. It's really important to give young kids nutrition to keep that. That's a hard decision.

What was your favorite subject in high school, and why did you love it?

Math because honestly numbers just clicked in my brain. I also really liked English, because being from Mexico and speaking Spanish at home, you've got to pick it up and learn it and everything.

If you could give a piece of advice to your younger self, what would it be?

Make good decisions.

If you could have any superpower, what would it be?

I would want to be able to fly. I think being able to fly over my farm and see it from that view would make life much easier.

If you could instantly learn any language, which would you choose and why?

I would like to learn Chinese Mandarin because that is the top language, the language that everyone speaks everywhere.

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Stakeholder Interviews

Continued

Corporate Farm Manager

Kevin Tottino
Production Manager at Ocean Mist Farms based near Monterey, California

What do you think about GMOs?

I believe that if GMOs solve the problem of feeding the world in a cost-effective way and are monitored, I am all for it. Alfalfa, corn, and cotton are the top three GMO crops. These crops are important in feeding the world and the products they produce. They have been altered to be tolerant to herbicide, this is so important because without that ability these plants would be overtaken. Weeds grow so much faster than these plants and if these plants need to compete against an aggressive weed that one cannot mitigate with an herbicide it is not worth it.

The argument is that organic products do not contain GMOs—the public must realize how much more expensive that is to grow. Now you, as a farmer, are competing with these weeds and pests head on. This becomes extremely expensive and the U.S. consumer wants a cheap product. These organic products can cost two to three times more to produce. I am all for this and would buy these organic products for my family but is the consumer really going to pay two to three times more for it? This means cereal, protein, milk, corn, potatoes, etc. These foods and products are staples and if they are two to three times more to produce for the everyday consumer, that's tough.

What are your thoughts about Golden Rice?

I think Golden Rice has its place in our world and that's feeding the extremely impoverished. The argument against Golden Rice is to just add an easy supplement to people's diet. Let's be real, that's expensive, a huge hassle and time consuming, and relies on people continuing to take the supplement every day as well. I would rather see the impoverished fed and improve their wellbeing, then see them die due to malnutrition.

What was your favorite subject in high school, and why did you love it?

As a child, I wanted to be a race car driver but I knew that wouldn't work out. I've always enjoyed working with family and I've always been passionate about working with anything mechanical, so in school I really liked math. I am a logical thinker and like to work at solving problems. Agriculture is a tight community and there are many careers within it beyond traditional farming.

If you could give a piece of advice to your younger self, what would it be?

Be patient. Changes will always take longer than we expect. Stay focused on the end goal.

Also, relationships are so important in life and business. It takes a huge amount of time and effort to foster those relationships. Choose them wisely!

If you could have any superpower, what would it be?

The ability to transport anywhere along with objects/people I am with.

If you could instantly learn any language, which would you choose and why?

Spanish. It is so important in California to speak Spanish whatever your job. I love traveling in Mexico so it would be great to be instantly fluent.

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Stakeholder Interviews

Continued

National Sustainable Agriculture Coalition Lobbyist

Wes King
Senior Policy Specialist at the National Sustainable Agriculture Coalition, an alliance that advocates for federal policy reform to advance the sustainability of food systems

What do you think about GMOs?

I will start by saying I think advocates against GMOs chose the wrong name to use—genetic modification happens all the time, and has for millions of years. So, my reaction to the term GMO is that it is entirely commonplace and part of life. If you are asking my opinion on crops created with transgenic modification —I am personally skeptical of it. It is very different to talk about taking genetic material from one species and splicing into the genes of another in a manner that could not happen in nature. I am not hesitant towards transgenic modifications because of health risks— there is no evidence that they are dangerous for personal health. I am skeptical of it more for cultural reasons. It captures farmers into an ever expanding financial expenditure. It locks them into buying specific seeds, or specific chemicals to control the growth of those seeds.

How do GMOs play into your daily life or work?

I have a weakness for corn chips, so I guess, like many, I do eat GMO foods. Beyond that, I am a label reader. I am privileged to be able to spend more money on food than most might be able to, and given the choice I will spend more on organic certified foods. As explained above, not because I worry about my personal health, more because I understand the larger landscape and cultural issues

What are your thoughts about Golden Rice?

I am skeptical. I'm not against it because of the technology. I understand why there are efforts to develop and promote Golden Rice, but as someone who does a lot of work with smaller local and state organizations, I have to ask— do the communities that Golden Rice is intended for want it? Can we instead focus on solving the larger economic forces that cause malnourishment in the first place? I don't see how creating systems of dependency on high tech food products that were developed by a company thousands of miles away is the ideal solution. I'd rather us focus on trade and other economic factors to help communities that are economically depressed.

If you could instantly learn any language, which would you choose and why?

Spanish. Just for practicality reasons. I live in a community that is about one-third Black, one-third Hispanic, and one-third white, and I'd love to be able to instantly communicate with everyone I live near. I've traveled a lot in Central and South America, so I have enough Spanish to get by, but would love to actually be fluent.

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Stakeholder Interviews

Continued

Economist

Arnold Kling, PhD
Economy and Statistics Scholar at Berman Hebrew Academy, a school in Rockville, Maryland

What do you think about GMOs?

I am fine with them. I am an economist, not a biologist or a chemist. I have to decide whose opinions to trust. I gather that most scientists are comfortable with GMOs, and that the opposition to them tends to come from people who are not scientists. That is probably what makes me most comfortable with GMOs. There is an argument that man has changed the genetic profile of plants and domesticated animals by breeding for centuries and so there is nothing new about creating a new strain of rice.

How do GMOs play into your daily life or work?

I probably eat them without knowing. Again, humans have been breeding plants and animals for centuries.

What are your thoughts about Golden Rice?

As an economist, I am aware that people in underdeveloped countries are in a very different position than us. We can be just fine without Golden Rice. In other countries, people will be malnourished without it. So I think it is cruel to say that because some wealthy people think that GMOs are "impure" in some way, poor people have to suffer.

What was your favorite subject in high school, and why did you love it?

We had a course where we learned computer languages. I liked the challenge of doing that and I enjoyed getting results from coding.

If you could give a piece of advice to your younger self, what would it be?

Try folk dancing or square dancing; get involved with activities with people other than schoolmates

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Stakeholder Interviews

Continued

Non-Governmental Organization (NGO) Employee

Wanida Lewis, PhD
Food Scientist and Agriculture Consultant at The Kaisen Company

What do you think about GMOs?

I think GMOs are helpful as we look at how climate change will affect our agriculture ecosystem. GMOs are not a new phenomenon; however, there needs to be a limit for usage as too much of a good thing can always lead to altering the role of science.

How do GMOs play into your daily life or work?

I live in Accra, Ghana. I work to develop technical agricultural programs that support emerging economies in Africa. I help key stakeholders build relationships with each other. For example, I led a "Women In Ag Biotech" policy dialogue series to support collaborations between farmers, civil servants, academics, and journalists around agricultural biotechnology. I also work to understand and influence policy agendas as related to the productivity, effectiveness, and impact of crop development and to support environmentally responsible farming. Currently, the use of GMOs is not as prevalent here in Ghana, but they are used in Ethiopia, South Africa, and Liberia. I'm sure these issues will come up again as the country has a policy of biotechnology including GMOs.

What are your thoughts about Golden Rice?

I think we have to remember that not all minerals can be absorbed by everyone. It's a great option but we have to keep in mind what are the side effects from that.

What was your favorite subject in high school, and why did you love it?

Chemistry, as it was challenging and caused me to think differently. It felt like putting together a puzzle.

If you could give a piece of advice to your younger self, what would it be?

Let it go and let it flow.

What is your most used phone app?

Instagram.

What's a social cause you care about?

Black Lives Matter. I am also passionate about supporting women in Africa to develop agribusinesses and create gender equality in agriculture.

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Stakeholder Interviews

Continued

Bioethicist

Andrew Flescher, PhD
Professor of Bioethics and Social Policy at Stony Brook University

What do you think about GMOs?

Whereas I harbor concerns about some powerful forms of genetic editing such as CRISPR, due to safety issues, off-target consequences, social justice issues, implications for eugenics, and even for the philosophical reason that getting rid of whole forms of human debility impacts in interesting ways human flourishing itself, these misgivings of mine are generally restricted for technologies that are geared for germline editing, i.e., those that permanently alter the gene pool, in animals and human beings. By contrast I do not think GMOs in and of themselves, particularly in crops, are bad for human health and I have seen no evidence to suggest they are in the 20 plus years that they have been on the market. As far as I have seen, there is no difference between GMO and non-GMO products, but GMOs have managed to address certain logistical challenges in food production. This counts in their favor. On the balance, I suppose I am therefore moderately supportive.

Research: Genetically Modified Foods and Social Concerns

How do GMOs play into your daily life or work?

In all sorts of ways I am sure, without me being acutely aware of it. Corn, soybeans, canola, sugar beets, etc., are ubiquitous in our food supply whether or not we intend to eat these foods directly. They are in processed foods (which I try to avoid). They are found in ingredients in restaurants.

What are your thoughts about Golden Rice?

I can see its benefits. I don't think it would cost more, and maybe would cost less, than white rice, and it seems healthier. In terms of how to characterize it, I'd say it is a species of the larger genus of plant-based GMOs, as I describe them above, so not overtly controversial to me for the same reasons I specify above. Given the Vitamin A benefits, until I hear this is unsafe, I am a supporter.

If you could give a piece of advice to your younger self, what would it be?

Seek not the approbation of others and live without fear of anything. Be unrestrained in this respect, so long as, in all things, you treat others with respect and are nice to everyone, always. Do not take a summer job you are bound to hate, like I did in high school and college. Life is too short, and time is more precious than money, even at that age.

If you could instantly learn any language, which would you choose and why?

This one is easy. I am a new father, and I think I know what my adorable baby daughter is thinking and feeling (she's nine months and change). But oh boy would I love to speak "Raya," and know exactly what life looks like from her point of view instead of just doing educated guess work.

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Stakeholder Interviews

Continued

Nutritionist

Amanda Thomas
Registered Dietitian at a school district near San Diego, California

What do you think about GMOs?

Genetically Modified Foods can sometimes be more nutritious and beneficial compared to conventional foods due to the ability to manipulate their nutrition profile in a positive way. However, there is also limited research which shows that some forms of genetically modified foods may increase risk of certain disease. I think that GMOs are safe in moderation.

How do GMOs play into your daily life or work?

As a registered dietitian, my clients constantly ask me about the safety of consuming GMOs. It is estimated that approximately 80% of the foods offered in the supermarket contain at least one GMO ingredient. They are typically more feasible for the consumer because they are easier to grow from a farming/gardening stand point. However, due to the inconclusive evidence surrounding the long-term effects of GMO consumption, I typically advise my clients to be aware of the GMO foods that they are purchasing and consuming and to avoid excess consumption of GMO foods.

What are your thoughts about Golden Rice?

Golden Rice was first introduced in order to help fight blindness in areas where Vitamin A intake is low due to decreased availability of foods that contain beta carotene. I think that this is a good example of how genetically modified foods can benefit the human body by providing us with a food that has an overall stronger nutrition profile than the conventional version. However, most of the genetically modified foods that are on the market were not manipulated to achieve a stronger nutrition profile when compared to conventional foods.

What was your favorite subject in high school, and why did you love it?

Physiology was my favorite subject in high school. I loved learning about the human body and the functions of all of the organ systems.

If you could give a piece of advice to your younger self, what would it be?

Smile more and worry less. With hard work and positively, things always end up working out for the best.

If you could have any superpower, what would it be?

The ability to read minds so that I can always be one step ahead of everyone else!

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Stakeholder Interviews

Continued

Local Parent

Mike Santos
Middle School Teacher and Parent near San Francisco, California

What do you think about GMOs?

I don't think they should be modifying food at all. I think naturally grown is best. I don't see any correlation between anything that induces diseases from GMOs, but I think that we should not be playing God. Playing around with how things are not supposed to be.

How do GMOs play into your daily life or work?

As much as possible I try to steer away from anything GMO. So whenever I shop I prefer natural and local, so I know where it came from. If it's a GMO it gets into a grey area.

Research: Genetically Modified Foods and Social Concerns

What are your thoughts about Golden Rice?

I've heard of it a little bit. I would say it's better to stick with what we have. I've been eating rice for basically my entire life and I would prefer the natural. I might wonder if there were other medications or ways to combat blindness without modifying the food that we eat. I would rather increase funding for health programs and do education campaigns for kids and parents. I have a girl in middle school so I prefer her to eat natural and healthy food. The other day the school had a party and asked if it's ok if we serve her this, and I said yes because I don't want her to miss out on it, but I say keep it limited, keep the portions small.

What was your favorite subject in high school, and why did you love it?

Physics was my favorite subject. I actually loved measuring trajectories and the speed of objects, I got really fascinated with it. It's funny, and I hate to say it, but math was one of those subjects that I couldn't get into, but then with my physics class, because my teacher taught it almost as a story, and we always did fun cool projects, telling us about so many things that connected it. And then later on I discovered history, like the history of the Philippines. I love looking back at how people lived back then and how they were able to understand science back then with more limited technology and still creating amazing civilizations. I love learning how earlier generations lived, it's a great way for me to know the people.

If you could have any superpower, what would it be?

I would want to be able to travel instantly. Like that one superhero who can travel between realms instantly, all he has to do is make a circle with his hand and then he can walk right in. I want to go to London and have lunch, and then go to Hong Kong and have some dinner and then just for kicks let's see what's going on in Korea, and then still be home in time to put my girl to bed. I just really love traveling and learning about culture and that would let me without having to go a long distance or pay for it!

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Stakeholder Interviews

Continued

Sustainability Manager

Dylan Welch
CEO Green.Org, a news platform that highlights leaders in renewable energy, cleantech, and sustainability

What do you think about GMOs?

I started Green.Org as a way to use mass media, social media, the Internet, and other communication platforms to educate people around the world about how to live more sustainably and environmentally friendly. I think utilizing technology and science to improve our lives is important, and can have positive effects around the world. I trust our education systems and scientists who are working hard in the GMO field to feed more people and make our food more nutritious. This has been going on for thousands of years, and now we are able to use data and information to continue the process to make our food more efficient. With over 7.6 billion people on the planet who all need to eat every single day, we need to make sure we are doing it in the best way possible, including creating the healthiest food in the most economic way that also doesn't have negative effects on our planet.

How do GMOs play into your daily life or work?

I think we all probably eat more GMO than we even realize.

What are your thoughts about Golden Rice?

In my job I am fortunate enough to meet a lot of sustainability experts from various backgrounds. This is a complex issue that involves a thorough understanding of all stakeholders' values.

What's a social cause you care about?

Climate change and environmentalism. I think it is the biggest issue we face as humans. There are many other social causes that are important, but if we do not come together to work on the problems we face around climate change and making the Earth more sustainable, the other issues pale in comparison. This affects every single person on the planet in one way or another, and if we all educate ourselves about the problems we face, we can all make changes in our lives that will go a long way to make the world a cleaner, more sustainable place to live.

What was your favorite subject in high school, and why did you love it?

My favorite subject in high school was a film production class I took. I saw the power of mass media and mass communications, and wanted to explore a career in that field. I realized that with one piece of content, whether that is a video, a photo, or a written article, you can mass produce to influence millions of people, and hopefully for the good.

What's your favorite way to spend a day off?

My favorite way to spend a day off is at the beach, either playing volleyball, swimming, going snorkeling, or scuba diving. I also really enjoy my job and my work, so even on my days off I don't mind getting a little work in!

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How to Identify a Good Source

Four Ways to Differentiate a Good Source From a Bad Source

Source: 4 ways to differentiate a good source from a bad source

1 Check the domain name.

The domain of a website gives important clues to its credibility. You can find the domain name in the URL of the website - look at the three letters at the end of the site's domain name. For example, you may often see "edu" (educational), "gov" (government), "org" (nonprofit), and "com" (commercial). Generally, .edu and .gov websites are credible as they originate from accredited postsecondary educational institutions or US government offices. Nonprofit websites may also contain reliable information, but take some time to consider the organization's agenda to determine if it could be biased and contain inaccurate information. Commercial websites, such as those of reputable news organizations, can also be good sources, but do some investigation to look for signs of reliability.

2 Take a closer look at the source.

Does the article or study have any authors listed? If so, what is their education or experience—are their credentials listed? Does their background qualify them as an expert in this topic? Alternatively, do they cite or link to authoritative sources?

Additionally, check the date of publication. Is the information current? When was it last updated? In some cases, it may not matter if the source is older, but in fields of study where information can rapidly change, the data may be obsolete.

3 Search for additional information to back up what you have found.

As you find information, try to verify its authenticity and legitimacy using other reliable sites. Are there references to verify the information? Do other sources or experts agree? If you find another credible site that contradicts the original source, further research may be required.

4 Use certain sources only to jump-start additional research.

Wikipedia offers a large volume of information, but because its entries are created collaboratively by largely anonymous volunteers, its reliability can vary widely. In some cases, users deliberately place incorrect information on the site; in others, well-meaning users unintentionally introduce inaccuracies. For these reasons, you can use Wikipedia as a jumping-off point to spark more research (the References section typically has a number of external links), but not as a source on its own.

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Position Statement Capture Sheet

Directions
To prepare to participate as a pilot in the Socratic Seminar, describe your stakeholder's position on Golden Rice. Identify statements to support this position.

Stakeholder

Position statement

I am a ..... and

I believe that Golden Rice is a *good / bad (circle one)*

idea for this community because…

list up to three main points to support your position.

Statements
Support your position with as many claims as possible.

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Position Statement Capture Sheet

Continued

Source
Note each source of the summaries cited during the debate.

Prediction

List all the stakeholders you expect to be on your side during the debate.

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Counterclaim Capture Sheet

Directions
To prepare to participate as a copilot in the Socratic Seminar, describe the position of your pilot's stakeholder on Golden Rice. Identify statements to support this position.

Stakeholder

Position statement

I am a _____ and

I believe that Golden Rice is a *good / bad (circle one)*

idea for this community.

List up to three main points to support your position.

Continues next page >

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Counterclaim Capture Sheet

Continued

Stakeholder *Which stakeholders might be against your position in the debate?*	**Potential claim** *What points might they make during the debate to make your position weaker?*	**Counterclaim** *What can you say to refute or prove their claim wrong?*	**Source for counterclaim**

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Individual Reflection Capture Sheet

Directions
Reflect on your role during the Socratic Seminar.
Examine your stance as you answer the questions.

1. Were you the pilot or a co-pilot?

2. How do you feel you did in your role?

3. Rate how your group worked prior to the debate on a scale of 1 (horribly with little communication) to 5 (really well, we all did our part). Why did you rank that number?

4. Rate how your group worked during the debate on a scale of 1 (horribly with little communication) to 5 (really well, we all did our part). Why did you rank that number?

5. Before the debate, what was your position on Golden Rice for the Philippines?

6. After the debate, has your position changed? Why or why not?

Continues next page >

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Individual Reflection Capture Sheet

Continued

7. Which stakeholder had the most convincing argument? What points did that person bring up that really helped the argument?

8. How was (or should) safety be taken into consideration for GE product production?

9. Do you think a product such as Golden Rice would be good for your community? Why or why not?

10. Who would the stakeholders in your community be if Golden Rice was brought in for debate?

11. What limitations existed in this activity? In other words, how could this activity have been improved to be more culturally responsive or encompassing a larger range of perspectives?